

Dxplain on the World Wide Web

G. Octo Barnett, M.D., Edward Hoffer, M.D., Richard J. Kim, Kathleen T. Famiglietti
Department of Medicine, Harvard Medical School
Laboratory of Computer Science, Massachusetts General Hospital
Boston, MA 02114

Dxplain, a computer-based medical education, reference and decision support system, was developed by the Laboratory of Computer Science over ten years ago and has been used by thousands of physicians and medical students on stand-alone systems, over communications networks, and now on the Internet via World Wide Web (WWW). This demonstration of the latest developments in Dxplain's evolution will review Dxplain's functionality, examine the new user interface and other applications with links to Dxplain's knowledge base, and discuss design considerations for the connectionless client environment.

Dxplain has the characteristics of an electronic medical textbook, a medical reference system and a decision support tool. In the role of a medical textbook, Dxplain can provide a comprehensive description and selected references for over 2,000 different diseases, emphasizing the signs and symptoms that occur in each disease, the etiology, the pathology, and the prognosis. As a decision support tool, Dxplain uses its knowledge base of the crude probabilities of over 5,000 clinical manifestations associated with over 2,000 different diseases. The system uses an interactive format to collect clinical information and makes use of a modified form of Bayesian logic to produce a ranked list of diagnoses which might be associated with the clinical manifestations. Dxplain uses this same knowledge base and logic to list other findings that, if present, would support the particular disease, and also lists what findings entered by the user are not usually found in the particular disease.

In recent years, the Dxplain authors were faced with the design and developmental challenges of converting the interface from a character-based, command oriented approach to a graphical user interface which would facilitate data entry and access to the vast amount of information in the knowledge base. A simultaneous development was the increasing demand to provide Dxplain's knowledge and analytical capabilities as a resource to other applications within MGH and at outside institutions.

In addition, issues related to the distribution of Dxplain remained a constant concern: platform dependence, installation support, database updates and integrity, copyright infringement, and user isolation with the resulting difficulty of obtaining feedback from users.

The growing availability of Internet access provides a potential solution for Dxplain distribution. In the last few months we have made Dxplain available over the Internet with both the Dxplain users and the developers maintaining platform independence and allowing revised versions to be made available immediately. Over a dozen major medical institutions and many physicians now access Dxplain over the Internet. The interface uses a Common Gateway Interface (CGI) program on a server at the LCS and the HTML form structure to dynamically generate pages. A number of design considerations for the Web environment will be discussed: 1) reducing the amount of dialog as Dxplain attempts to match the user's narrative text entries; 2) maintaining a session state even though the interaction is a series of separate connections with the server; 3) selecting the appropriate browser techniques for presenting information and simplifying user input; 4) taking advantage of the browser's capabilities to offer alternative protocols for the user to explore the knowledge base; and 5) providing the appropriate degree of security by restricting access to licensed users or licensed institutions.

One of the exciting recent design changes is the separation of the retrieval and analytical functions from any dependence on the interface itself. One protocol allows execution of individual functions through socket connections to the server over the Internet. A second protocol allows the remote user to communicate using HTTP and use forms submission to pass a set of name value pairs. The LCS Dxplain Web server then takes control of the user interaction. Collaborators from institutions outside of MGH are now accessing Dxplain knowledge to enhance their applications and to integrate the Dxplain capabilities into the local institutional medical information system. For example, the staff of the Department of Medical Informatics of Columbia University are integrating Dxplain interpretations with their laboratory reporting module. We will demonstrate examples of this integration capability and welcome discussion with other institutions interested in collaboration in the remote access of Dxplain services and integration of these services in their local workstation environment.

This work was supported in part by NLM research grants LM5854 and N01-LM4-3512 and in part by an equipment grant from Hewlett Packard Company.